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European Society of Anaesthesiology

ESA

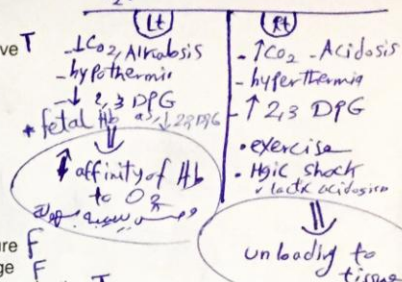
\* In high altitude (moderate)  
→ Shift of Curve to RT due to Influence of 2,3 DPG  
→ In extreme altitude → shift to LT  
or ↓ CO<sub>2</sub> (respiratory alkalosis).

### Sample questions ITA/Part I Paper A

Inadequate tissue oxygenation may occur, in spite of a normal PaO<sub>2</sub>, in the presence of

- A. anaemia T
- B. a shift to the left of the oxyhemoglobin dissociation curve T
- C. low cardiac output T
- D. local vasoconstriction T
- E. metabolic alkalosis T

O<sub>2</sub>/Hb dissociation curve



2. Which of the following statements are true?

Chemoreceptors for PH, PO<sub>2</sub>, PCO<sub>2</sub>, Temp

Sensitive to stretch

- A. the carotid bodies are sensitive to arterial blood pressure F
- B. hypotension produces increased baroreceptor discharge F
- C. increased plasma renin activity stimulates aldosterone production T
- D. posture influences aldosterone production T
- E. antidiuretic hormone secretion is increased in systemic hypotension T

3. The elastic tissue within the arterial system

- A. allows transitory storage of the major part of the stroke volume during the ejection phase F
- B. contributes to the onward flow of blood during ventricular diastole T
- C. minimises the effects of intrathoracic pressure upon aortic pressure F
- D. contributes to conversion from intermittent to continuous blood flow T
- E. maintains coronary perfusion T

4. During sustained severe exercise the

- A. oxygen saturation of mixed venous blood remains above 70 per cent F
- B. minute volume of ventilation may reach 130 litres T
- C. pulmonary vascular resistance falls T
- D. cardiac output may reach 50 litres/min T
- E. core temperature may reach 40°C T

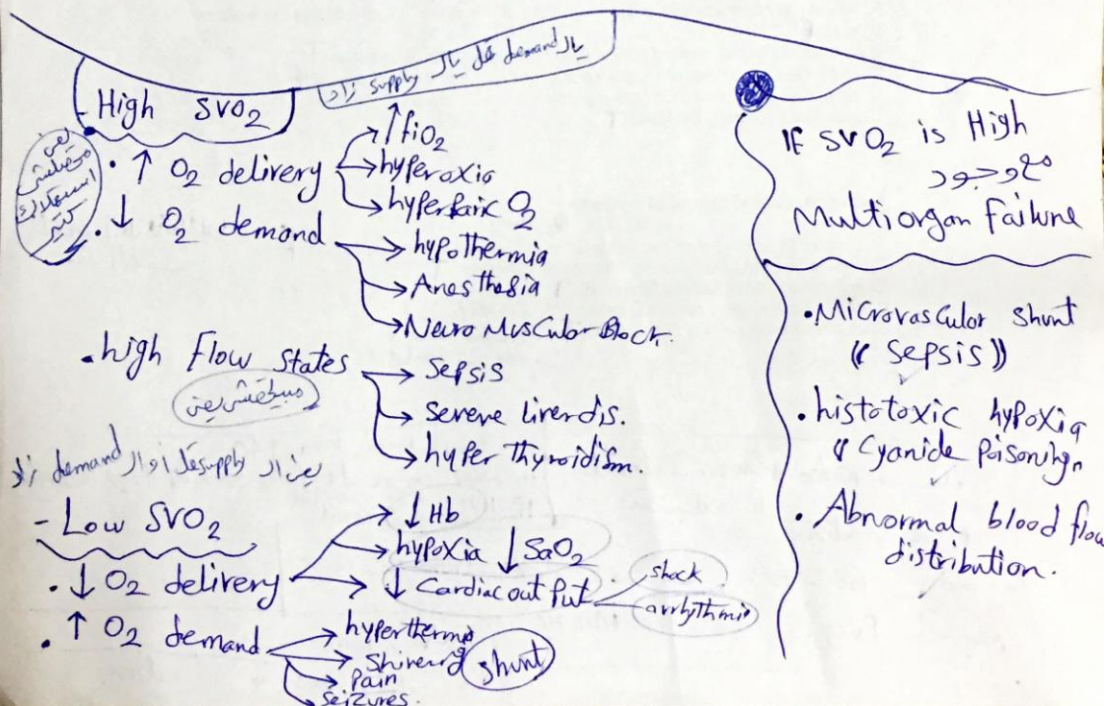
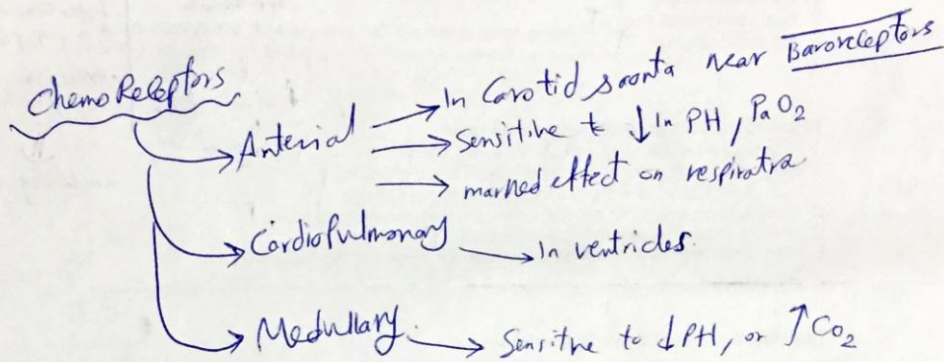
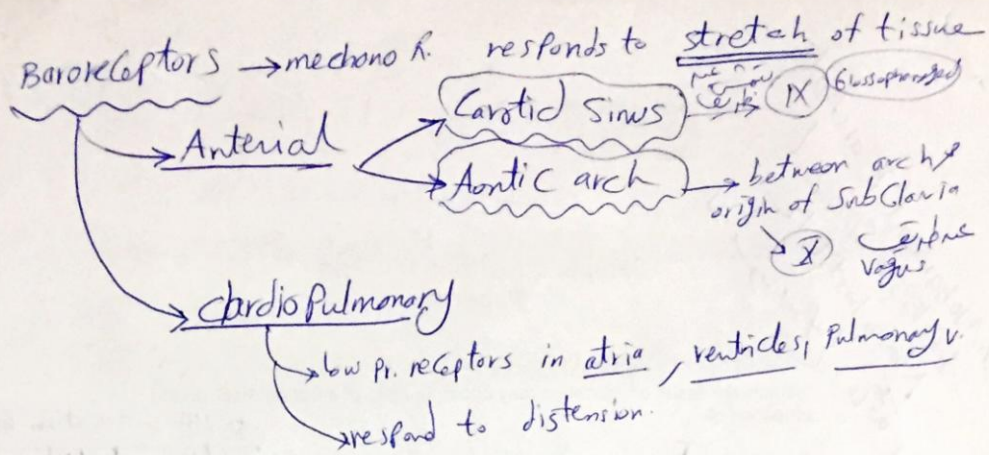
25-40 L  
21 L → active pt  
35 L → athletes

via sample blood from PAC  
measure end result of O<sub>2</sub> consumption & delivery  
if low → ↑ consumption  
→ ↑ demand

SVO<sub>2</sub> → mixed venous saturation  
tissue O<sub>2</sub> delivery  
normally 65-75% → O<sub>2</sub> extraction 25-35%  
Normal PvO<sub>2</sub> → 35-45 mmHg

ScVO<sub>2</sub>

Central venous O<sub>2</sub> saturation





Pressure ↑  $\Delta$  LV  $\Delta$  Contractility ↑  $\Delta$  LV  $\Delta$    
 Rate of Pressure rise in ventricles   
 Ventricular Contractility assessment

5. Ventricular dP/dt is increased by an increase in

- A. after-load
- B. pre-load
- C. myocardial contractility
- D. ionized calcium concentration
- E. heart rate

T

6. In the normal pulmonary vascular bed

- A. the mean arterial pressure is half the mean aortic pressure F
- B. the vascular resistance is lower than the systemic vascular resistance T
- C. 50% of the total blood volume is present at rest F
- D. the wedge pressure equals the capillary pressure F
- E. hypoxia causes dilation of vessels F

HIV

Hypoxia  $\rightarrow$  dilatation in Systemic   
 $\rightarrow$  Constriction in Pulmonary

7. Intra-pleural pressure is

- A. subatmospheric T -ve Pressure
- B. related to mid-oesophageal pressure T
- C. changing throughout the ventilatory cycle T
- D. equal throughout the pleural space F
- E. increased by coughing T

8. Closing capacity

- A. normally exceeds residual volume T
- B. decreases in the supine position F
- C. is the sum of closing volume and residual volume T
- D. decreases with age F or age
- E. is normally less than functional residual capacity T

Volume of lung at which its smallest airway, Resp. bronchioles collapse

Closing Capacity = closing volume + Residual volume

9. Intrapulmonary shunts increase

- A. mixed venous oxygen tension F
- B. arterial oxygen saturation F
- C. when pulmonary blood flow is partially obstructed F
- D. in the presence of atelectasis T
- E. with severe fluid overload T

shunt is not  $\rightarrow$  alveoli is collapsed  $\rightarrow$  No ventilation   
 enough air within lung airway to keep air way open during  $\uparrow \downarrow$

shunt  $\rightarrow$  Perfusion of non-ventilated area   
 dead space  $\rightarrow$  ventilation of non-perfused area   
 shunt  $\rightarrow$  anatomical   
 pathological

Blood in area  $\hat{=}$  shunt receive NO Oxygen   
 so, Arterial hypoxemia which minimally responsive to  $O_2$  supplement   
 - occur when alveoli filled  $\hat{=}$  fluid   
 - so, main cause of hypoxia during P. edema, pneumonia

$PAO_2$   $me$   $dot$   $PAO_2$   $cu$   
 $PAO_2$   $dot$   $PAO_2$   $cu$   
 $PAO_2$   $dot$   $PAO_2$   $cu$

Coronary bl. V. <sup>drains</sup>  
drain directly to Lt ventricle.

shunt is  $\downarrow$  by Pulmonary vaso constriction  
hypoxia. ✓

$$FRC = \underline{ERV} + \underline{RV}$$

نہایت زیادہ  
closing capacity

Small air way  
→  
Bronchioles  
don't collapse

Partial Pn of O<sub>2</sub> at which 50% of Hb Saturated  
(26.6 mm Hg / 3.5 kPa)

10. The symbol P50 refers to the

- (3.5 kPa) (27.6 mmHg)
- A. partial pressure of oxygen at 50 mmHg (6.7 kPa) F
  - B. PaO<sub>2</sub> at which the oxygen content is 50 ml/100 ml blood F
  - C. percentage saturation of hemoglobin at a PaO<sub>2</sub> of 50 mmHg (6.7 kPa) F
  - D. oxygen content of plasma at a PaO<sub>2</sub> of 50 mmHg (6.7 kPa) F
  - E. PO<sub>2</sub> at which the hemoglobin is 50% saturated T

11. Pituitary feedback mechanism regulates secretion of

- A. ACTH T
- B. adrenaline F
- C. cortisol T
- D. insulin F
- E. thyroxine T

12. Cerebrospinal fluid

- 4 hrs F (25 mL/hr)
- A. production in an adult is 150 ml/24 h F
  - B. is mainly reabsorbed in the lateral ventricles F
  - C. does not accurately reflect acute changes in base excess in arterial blood T
  - D. is virtually free of glucose F
  - E. specific gravity (relative density) is 1015-1020 F
- arachnoid villi → venous circulation / lymphatics
- (1004 - 1006 / 1006 - 1008)

13. The transmitter substances in all the ganglia of the autonomic nervous system include

- A. acetylcholine T
  - B. noradrenaline f
  - C. 5-hydroxytryptamine f
  - D. butyrylcholine f
  - E. dopamine f
- Post Ganglionic → Ach → Para Symp / Symp Skeletal
- Noradrenaline → Symp
- dopamine → Endocrine / Symp / Renal

14. Inulin naturally occurring poly sacch.

- A. is totally removed from blood passing through the kidney F
- B. is not reabsorbed by the renal tubules T
- C. is secreted by renal tubular cells F
- D. is metabolised by renal tubular cells F
- E. has a concentration in glomerular filtrate which is the same as that in plasma T

Medically - help to measure kidney function by GFR - Volume of fluid Filtered from renal Glomerular capillaries into Bowman's Capsule.

- not secreted/absorbed in any appreciable amount at nephron.

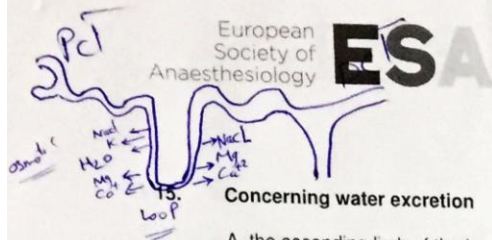
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\* Plasma osmolality ( $\sim 290 \text{ mOsm/kg H}_2\text{O}$ )

\* human urine osmolality (during night water intake same)

$\sim 1200 \text{ mOsm/kg H}_2\text{O}$   
4 times plasma



### Concerning water excretion

- A. the ascending limb of the Loop of Henle is impermeable to water T
- B. chloride reabsorption from the Loop of Henle occurs passively F
- C. under conditions of maximum antidiuresis, 5% of water reabsorption occurs in the distal tubule 1200
- D. the maximum medullary osmolality is 800 mosmols/LF
- E. dehydration induces aldosterone production T

descenting loop → distal reabsorption to water

### 16. The anion gap

$$= (\text{Na}^+) - (\text{Cl}^- + \text{HCO}_3^-) \approx 6-12$$

- A. is normally 12mmol/L T
- B. increases in lactic acidosis T
- C. s decreased in aspirin poisoning F
- D. decreases in diabetic ketoacidosis F
- E. is increased in renal failure T

High anion gap (non volatile acids) → exogenous: sulfate, methanol, ethanol; endogenous: lactic acid, ketoacids

$\text{HCO}_3^-$  ↓

Hyperchloremic

Acidosis & Normal AG: GI loss → diarrhea, fistula, renal loss → RTA, carbonic anhydrase inhibition, lactic acidosis

### Concerning carbonic acid and bicarbonate in the blood

- A. at pH 7.4, the ratio of bicarbonate to carbonic acid is 20 to 1 T
- B. the buffer system depends upon carbonic anhydrase T
- C. the hydrogen ion formed by carbonic acid is buffered by reduced haemoglobin T
- D. the Henderson-Hasselbalch equation describes the buffer equilibrium T
- E. extracellular buffering of excess hydrogen ions occurs instantaneously T

### 18. Cytochrome P450

Enzyme has important role in metabolism, also metabolize toxic compounds like drugs, bilirubin.

- A. is an enzyme which regulates the speed of oxygen release from haemoglobin F
- B. is present in sympathetic nerve endings F
- C. participates in the metabolism of noradrenaline F
- D. is a terminal oxidase important in biotransformation of drugs T
- E. is a potent enzyme inducer F

### 19. In the movement of fluids and dissolved molecules

- A. diffusion is proportional to the permeability of the membrane T
- B. a non-diffusible anion will slow transfer of a diffusible cation T
- C. the trans-membrane potential depends upon the presence of non-diffusible ions T
- D. the osmotic pressure is necessary to prevent ionic migration F
- E. filtration is hydrostatic pressure dependent T

20. The stomach

- A. is responsible for the absorption of approximately 25% of the ingested protein **F**
- B. secretes vitamin B12 **F**
- C. acidity depends upon the activity of carbonic anhydrase in its parietal cells **T**
- D. decreases its motility when fat enters the intestine **T**
- E. is capable of large changes in capacity with small changes in pressure **T**

21. Labetalol

during exercise  
maintain  
volume

- A. can cause postural hypotension **T**
- B. reduces heart rate **T**
- C. has an elimination half-life of 24 hours **F** (6-8 hrs oral) (5.5 hr IV)
- D. is a more potent alpha than beta adrenoreceptor blocker **F** more selective  $\alpha$  than  $\beta$
- E. may cause bronchoconstriction (dyspnea) **T**

equivalent in both  
B-blocker is some  $\alpha$   
orally  $\alpha$  to B 1:3  
specific  $\alpha_1$  non-specific

22. Beta adrenoreceptor stimulant drugs can cause

- A. hyperglycaemia **T**
- B. hypokalaemia **T**
- C. increased gastrointestinal motility **F**
- D. skeletal muscle tremor **T**
- E. increased contractility of the pregnant uterus **F**

Smooth m. Relaxant  $\rightarrow$  lung  
B2  $\rightarrow$  Vessels  $\rightarrow$  uterus  
Stomach

B1  $\rightarrow$  +ve Inotrope, Chronotrope ( $\uparrow$  HR, BP)  
B2 in adipose  $\rightarrow$  Secretion from stomach (Ghrelin)  
Secretion from kidney

23. Reliable early signs of cyanide toxicity due to sodium nitroprusside infusion include

- A. progressive metabolic acidosis **T**
- B. abnormal electroencephalographic changes **F**
- C. increased mixed venous oxygen tension **T**
- D. constant response to low dose infusion of sodium nitroprusside **F**
- E. a decrease in haemoglobin saturation **F**

Nitroprusside  
Nitric acid  
Cyanide  
early  $\rightarrow$  vit B12 administration

early metabolic acidosis  
high anion gap  
high mixed venous O<sub>2</sub> tension

Sym: headache, vertigo, confusion  
Dyspnea, loss consciousness  
coma arrest

24. Effects of atropine instillation in the normal eye include

- A. paralysis of the sphincter pupillae muscle **T**
- B. paralysis of the ciliary muscle **T**
- C. increase in intra-ocular pressure **F**
- D. enophthalmos **F**
- E. photophobia **T**

Atropine eye  $\rightarrow$  Pupil dilatation  
Cycloplegic (Paralysis of accommodation)  
relax cholinergically innervated  
sphincter M. of iris, Ciliary muscle.



25. Intracranial blood volume is increased by

- A. halothane **T**
- B. vecuronium **F**
- C. thiopentone **F**
- D. nitroglycerine **T**
- E. ketamine **T**

26. Tinnitus may be caused by

- A. codeine **F**
- B. aspirin **T** *high doses*
- C. cocaine **F**
- D. lidocaine (lignocaine) **T**
- E. gentamycin **F** *as, Polymyxin B, erythromycin, Vancomycin, Neomycin.*

27. Cerebral oxygen consumption is significantly decreased by

- A. propofol **T**
- B. thiopentone **T**
- C. nimodipine **F** *→ Ca<sup>2+</sup> blocker For Cerebral Vaso Spasm*
- D. nitrous oxide **F**
- E. fentanyl **F** *Bl. Supply*

28. Uptake of an inhalational anaesthetic from the alveoli to the blood is influenced by the

- A. blood/gas partition coefficient of the agent
- B. alveolar ventilation
- C. cardiac output
- D. ventilation/perfusion ratio in the lung
- E. partial pressure gradient across the alveolar capillary membrane

29. Prolonged exposure to nitrous oxide

- A. inactivates vitamin B12 *via*
- B. interferes with methionine metabolism *Inhibits*
- C. interferes with folate metabolism *2*
- D. impairs deoxyribonucleic acid (DNA) synthesis
- E. produces megaloblastic haemopoiesis



30. Inhalational anaesthetic agents with a blood/gas partition coefficient of less than 2.6 include

- A. sevoflurane 0.65
- B. isoflurane 1.4
- C. desflurane 0.42
- D. halothane 2.4
- E. diethyl ether F

→ describe solubility of Inhaled GA in blood.  
→ The more soluble → the more higher blood-gas Partition Coefficient  
→ Induction rate & recovery

31. Anaphylaxis to intravenous anaesthetics

- A. is prevented by antihistamine premedication F
- B. is characterised by profound hypotension T
- C. only occurs with prior exposure F
- D. is associated with elevated serum tryptase concentrations T
- E. is dose related F

32. Ketamine

- A. sensitises the myocardium to adrenaline T
- B. is a butyrophenone derivative F
- C. is poorly soluble in water F
- D. causes bronchoconstriction F
- E. has a marked chronotropic effect T

Phencyclidine derivatives.

→ Soluble in water pKa 7.5

33. Concerning propofol

- A. it has a high clearance rate in excess of liver blood flow T
- B. extra-hepatic metabolism occurs to a significant extent T
- C. significant reduction in the volume of distribution occurs in elderly patients F
- D. it may induce burst suppression of EEG activity T
- E. clearance is 870-2140 ml/min T

High clearance chch  
→ Rapid redistribution  
→ Hepatic & Extrahepatic metabolism  
→ Renal & Extra renal clearance  
→ No active metabolites

34. Local anaesthetic agents primarily biotransformed in the liver include

- A. ropivacaine T
- B. prilocaine T
- C. lignocaine (lidocaine) T
- D. procaine F
- E. bupivacaine T

Less Cardiotoxic

esters by cholinesterase

Ester → Articaine, Chlorprocaine

Amide

- Bupivacaine
- Etidocaine
- Lidocaine
- Mepivacaine
- Ropivacaine
- Prilocaine

metabolized in liver by Plasma cholinesterase

metabolized in liver by Cytochrome P450

**Cyanosis** ↓  $\text{PaO}_2$  → normal

**Hyperbolic  $\text{O}_2$  exchange transfusion**

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**Drugs Causing Met Hb**

- Prilocaine
- Lidocaine
- benzocaine
- Nitroglycerine
- Na Nitroprusside
- Sulfonamide
- Metoclopramide

**Sum**

- Central Cyanosis
- headache
- Fatigue
- Dyspnea
- ~~rest~~ depression
- shock
- Seizures
- death

**85. Toxic effects of amide local anaesthetics include**

- A. myocardial depression **T**
- B. methaemoglobinemia **T**
- C. central nervous system depression **T**
- D. bronchospasm **F**
- E. convulsions **T**

**Prilocaine** in EMLA Cream

**Methaemoglobinemia**

Altered state of Hb in which  $\text{Fe}^{+2}$  oxidized to  $\text{Fe}^{+3}$  (ferric) → unable to bind to  $\text{O}_2$

**36. Concerning pharmacokinetics:**

- A. only non-ionised drugs will readily distribute into the lipid phase of membranes **T**
- B. propofol has a high clearance **T**
- C. for a given clearance, the elimination half life of a drug is directly proportional to the volume of distribution **T**
- D. drugs with a low extraction ratio are affected by hepatic blood flow **F**
- E. the clearance of lidocaine (lignocaine) approaches hepatic blood flow **T**

**37. Recognised factors in the inactivation of mivacurium include**

- A. glomerular filtration **F**
- B. protein binding **F**
- C. hepatic biotransformation **T**
- D. hydrolysis by plasma cholinesterase **T**
- E. blood pH **F**

**by plasma cholinesterase**

**Esters local Anesth**

- Procaine
- tetracaine
- Chlorprocaine

**38. Morphine may provoke**

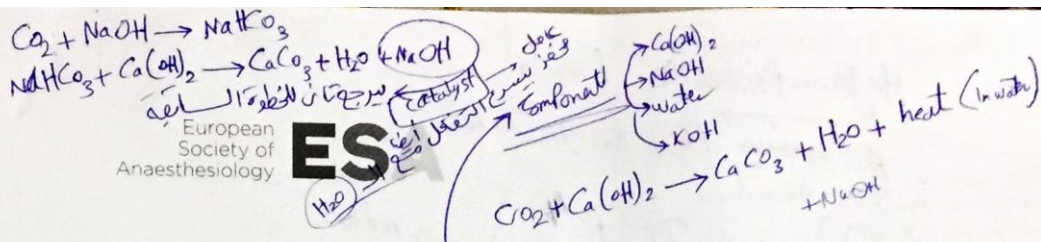
- A. nausea and vomiting **T**
- B. bronchoconstriction **T**
- C. increased output of urine **F**
- D. constipation **T**
- E. constriction of the pupils **T**

**39. Platelet aggregation is reduced by**

- A. acetylsalicylic acid **T**
- B. dipyridamole **T**
- C. tranexamic acid **F**
- D. ketorolac **T**
- E. dextran **T**

**shift  $\text{O}_2$  Hb DC to left** as difficult to release  $\text{O}_2$





ES

45. The reaction of carbon dioxide with soda lime includes the

46. Poiseuille's law states that flow rate is proportional to the

portional to the

$$Q = \frac{\pi R^4 \Delta P}{8 \eta L}$$

radius of pipe  
Pressure gradient  $P_1 - P_2$   
length  
viscosity

47. Concerning the pneumotachograph:

disadv.  
very sensitive to  
Temp. / humidity,  
atmospheric Pr.

48. Recognised methods of effectively reducing operating room concentrations of waste volatile anaesthetic gases include

49. Concerning heat loss during anaesthesia:

less important  
Anesth if on metal

### Hypothermia effect

Crs  $\begin{cases} \rightarrow \text{arrhythmia} \\ \rightarrow \downarrow \text{CoP} \\ \rightarrow \downarrow \text{O}_2 \text{ delivery} \end{cases}$

-  $\uparrow$   $O_2$  consumption during mild hypothermia. ( $34^\circ C$ )  
also, during rewarming  $\rightarrow$  shiver

- ↑ Bl. viscosity
- Mild acidosis

(air saturated with water)  
sweat evaporate more slowly

Shift to Lt.

→ Shivering by soot.

- Potentiate action of M.R.
- ↓ Metabolic rate

- ✓ Radiation 50%
- ✓ Convection 30%
- ✓ Evaporation ~ 20%
- Conduction
- Respiration 10%
- Anaesthesia

## Hagen Poiseuille formula For laminar flow through tubes.

$$Q = \frac{\Delta P \pi R^4}{8 \eta L}$$

Flow  $\rightarrow Q$   
 Pressure difference  $\rightarrow \Delta P$   
 radius  $\rightarrow R$   
 length  $\rightarrow L$   
 viscosity  $\rightarrow \eta$

### Clinical Application

- Transfusion  $\rightarrow$  Double needle diameter  
 Pressure  $\rightarrow$   $\frac{1}{2}$  viscosity  $\rightarrow$   $\frac{1}{2}$

- III of hypovolemic shock  $\rightarrow$  Tissue Perfusion  $\uparrow$  by  $\begin{cases} \uparrow \text{blood volume} \\ \text{Lower peripheral resistance} \end{cases}$

- In Controlled hypotension  
 $P = Q \times R$   
 $\text{MAP} \leftarrow \text{COP} \rightarrow \text{systemic vascular resistance}$   
 so, if hypotension  $\rightarrow \downarrow Q$  or  $\downarrow R$

- In Anesth. breathing System For laminar flow use

.. Smooth Internal Surface tube

- Short as possible
- No Constrictions
- of Large diameter.
- Gradual bending.



- Silver tube (Regnault's) Hygrometer.
- wet & dry bulb hygrometer.
- Hair hygrometer.
- Electronic hygrometer.
- Mass Spectrometer → measure water vapor concentration in any gas mixture

50. The humidity of the atmosphere is measured by

- A. determining the dew point
- B. a wet and dry bulb thermometer
- C. cooling a known volume of air
- D. absorption of water by a hair
- E. measuring barometric pressure

Temp. at which RH > 100%, & water vapor condense to form vapor.

51. Techniques for measuring blood flow include

- A. ultrasound
- B. dye dilution
- C. plethysmography
- D. thermal dilution
- E. electromagnetism

52. Pressure in the superior vena cava is influenced by the

- A. right ventricular performance
- B. position of the patient
- C. intra-abdominal pressure
- D. mean airway pressure
- E. competence of the tricuspid valve

53. volume of air exhaled which doesn't stay in gas exchange  
→ Anatomical dead space  
not perfused area

It is necessary to know the arterial PCO<sub>2</sub> in order to measure

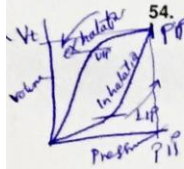
- A. carbon dioxide output
- B. physiological dead space
- C. minute volume of ventilation
- D. residual lung volume
- E. functional residual capacity

$$\frac{1}{3} TV$$

$$\frac{V_d}{V_t} = \frac{P_a CO_2 - P_e CO_2}{P_a CO_2}$$

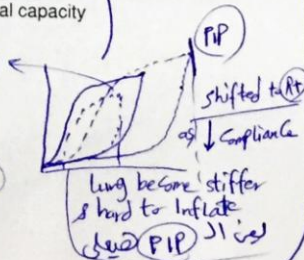
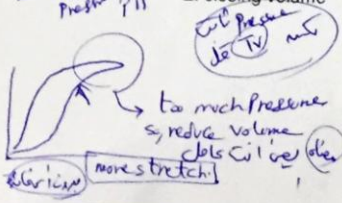
dead space  
tidal volume  
Partial Press. of CO<sub>2</sub> in artery

Bohr equation



A pressure volume loop can measure

- A. lung compliance
- B. airway resistance
- C. intra-pleural pressure
- D. functional residual capacity
- E. closing volume



Shallow breath  
dead space

For Alveolar CO<sub>2</sub>

For Anatomical

$$P_a CO_2 - P_{mixed} \text{ expired } CO_2$$

nitrogen desaturation

\* ventilated  
Rate 10 x TV 500  
Rate 20 x TV 250  
MV 5L  
10 x 500 = 5000  
20 x 250 = 5000

\* Taking deep breath more slowly is better than shallow breath quickly.

55. Measurement of the relationship between intracranial pressure and volume assesses

- A. the integrity of the blood-brain barrier
- B. cerebral compliance
- C. cerebral blood flow
- D. cerebral metabolic rate
- E. cerebral vascular diameter

Volume & pressure  
Compliance

56. In a supine young adult with a residual volume of 1200 ml

- A. closing volume will decrease with increasing age
- B. closing volume will be approximately 1000 ml
- C. closing capacity will be decreased by general anesthesia
- D. closing capacity is approximately 1700 ml
- E. total lung capacity is about 5000 ml

↑ age  
FRC  
GA ↓

57. Concerning manometers:

$1 \text{ mmHg} = 1.36 \text{ cm H}_2\text{O} = 1 \text{ torr}$   
 $1 \text{ atm} = 1 \text{ bar} = 101.3 \text{ kPa} = 760 \text{ mmHg} = 1030 \text{ cm H}_2\text{O} = 15 \text{ PSI}$

- A. pressure which supports a 10mm column of mercury will support a 13.6cm column of water
- B. 1 kPa is equal to a pressure of 7.5mm Hg
- C. the two limbs of a fluid manometer must be of equal diameter
- D. a mercury barometer used to measure atmospheric pressure is sealed with a vacuum above the surface of the liquid
- E. aneroid gauges do not contain liquid

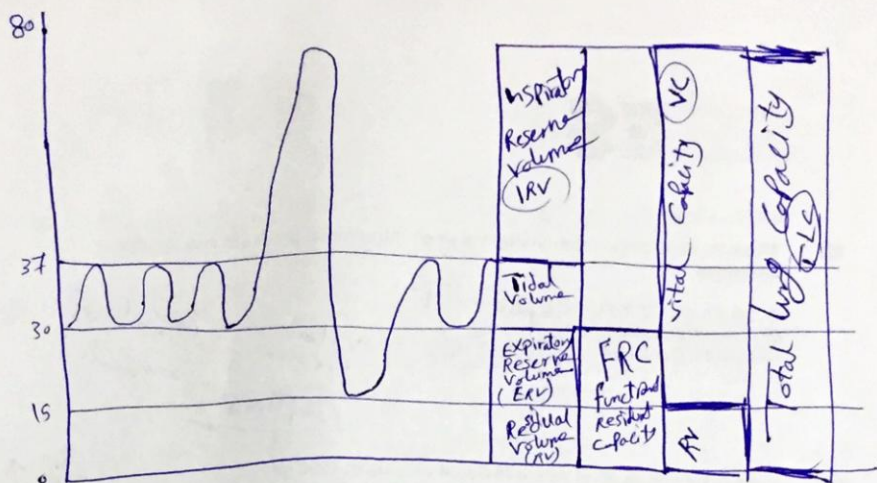
↳ Bourdon gauge  
like aneroid

58. Concerning the measurement of body fluid spaces:

- A. indocyanine green is excreted unchanged in the urine
- B. extracellular fluid volume is measured using deuterium
- C. intracellular fluid volume is measured indirectly from extracellular volume and total body water
- D. plasma volume is measured with iodine labelled serum albumin
- E. chromium labelled red cells are used to measure blood volume

~~Dalton's law~~  
Concentration of volatile  
= Vapor Pressure / Atmospheric P.





$$FRC = ERV + RV$$

2400 mL in 80 kg

Spirometry - measure, review of

RV review

↓  
Nitrogen wash out, helium dilution  
body plethysmography.

Closing Capacity

$$= RV + \text{closing volume}$$

Young → closing Capacity 10% of VC

erect P. → closing = FRC = 40% of VC  
in 60 yrs.

Supine → closing = FRC at 44 yrs

Neonate → lung elastic recoil is ↓  
• More airway closure  
• closing C > FRC  
• ↓ PaO<sub>2</sub>

Closing volume

Volume of lung inflated when  
small airway in dependent parts of  
lung start to collapse during expiration

Normally closing volume < FRC.  
to account for RV of lung at end of expiration

If closing volume encroach on FRC

airway closure may occur during normal  
expiration & ↓ ventilation

FRC remain > closing V.

closing volume ↑ with age.

In Supine closing V > FRC  
by mid 40s.

& in erect position by 60 yrs.

↓ FRC during GA ↓ below closing vol  
so, may ↑ V/Q mismatch.

59. The following can be used in the statistical analysis of the results of a clinical investigation

- A. unpaired t-test
- B.  $\chi^2$  (chi-squared) test
- C. analysis of variance
- D. sequential analysis
- E. paired t-test

60. Concerning the following statements:

- A. the null hypothesis states that the two treatments are equally effective T
- B. the significance level is a probability value that ensures that the outcome is clinically significant F
- C. the standard deviation is a measure of the central value of the sample F
- D. the standard error is used for the estimation of confidence intervals T
- E. blood pressure is measured on an ordinal scale F

1 atm = 1 bar = 760 mmHg = 1030 cm H<sub>2</sub>O = 15 PSI



Sample questions ITA/Part I  
Paper B

1. Mechanical hyperventilation in a normal patient during the entire course of anaesthesia is associated with

- A. markedly diminished requirements for post-operative analgesia F
- B. a shift to the right of the oxyhaemoglobin dissociation curve F
- C. a decrease in  $\text{PaO}_2$  F
- D. postoperative hypoventilation T
- E. cutaneous vasodilatation F

*hypoxia → VC*

2. Predictors of cardiac morbidity and mortality include

- A. aortic stenosis T
- B. myocardial infarction occurring 2 months previously T
- C. a prolonged QT (frequency corrected) interval T
- \* D. occasional ventricular extra-systoles F
- E. intra-operative nodal rhythm T

3. Patients with untreated hypothyroidism show

- A. resistance to hypnotics F
- B. depression of cardiac performance T
- C. high voltage T waves on the ECG F
- D. increased sensitivity to non-depolarising neuromuscular blocking drugs T
- E. delayed return of consciousness after anaesthesia T

*unstable, labile CVS.  
Extreme sensitivity to drugs that affect CVS.  
↑ Probability of severe resp. def.  
Myxedema coma PR by hypothermia, trauma, infection, Resp. depression*

4. Concerning therapy with anticholinergic drugs:

*hyoscine is the shortest*

- A. the action of glycopyrrolate is longer than atropine T
- B. atropine increases dead space T
- C. atropine premedication should be avoided in febrile children T
- D. 1.0 mg atropine produces complete vagal blockade in a 70 kg man F
- E. hyoscine (scopolamine) premedication should be avoided in elderly patients T

*- Pt. should be euthyroid  
- If Elective, mild dis.*

*→ Prolonged & Caution  
→ rely on Regional  
→ Temp. Control  
→ Steroid Screen*

*\* Atropine & hyoscine → Tertiary → cross BBB Patients  
\* Glycopyrrolate → Quaternary → doesn't cross*

*as, adrenal insuff. due to impairment of hypothalamo-pituitary-adrenal axis  
↓ response to stress*

*ER → Prolonged & Caution  
N<sub>2</sub>, T<sub>3</sub>, T<sub>4</sub>  
Slowly*

5. Intense peripheral vasoconstriction can be reversed with

- A. phentolamine T
- B. sodium nitroprusside T
- C. esmolol F
- D. nifedipine T
- E. high spinal anaesthesia T

ccB → Sympathectomy

6. Drugs known to increase barrier pressure at the gastro-oesophageal junction include

- A. droperidol F
- B. atropine F
- C. metoclopramide T
- D. fentanyl F
- E. neostigmine T

Dopamine autograft  
Antiemetic  
As Psychot

7. Recognised treatment of a post-operative thyrotoxic crisis includes

- A. sedation T
- B. plasmapheresis T
- C. corticosteroids T
- D. propranolol T
- E. calcitonin F

IF Hypocalcemic

8. Recognised complications of abdomino-perineal resection of the rectum include

- A. deep venous thrombosis T
- B. paralytic ileus F
- C. air embolism T
- D. postoperative atelectasis T
- E. uraemia F

Factors associated with the development of postoperative atelectasis include

- A. abdominal pain F
- B. COPD T
- C. ankylosing spondylitis T
- D. thoracic surgery T
- E. spinal anaesthesia F



14. Problems with routine preoperative chest X-rays include

- A. a high percentage of false positive T
- B. a high percentage of false negative T
- C. a considerable risk of radiation induced cancer f
- D. very few unsuspected positive findings T
- E. a high percentage of clinically insignificant, positive findings T

15. Venous air embolism is associated with

- A. arterial hypotension T
- B. a decrease in end-tidal carbon dioxide concentration T
- C. cardiac arrhythmias T
- D. a decrease in pulmonary vascular resistance f
- E. a decrease in intracranial pressure f

$\rightarrow \uparrow P_{aO_2} \rightarrow \uparrow P_{aCO_2} \rightarrow \uparrow ICP$

• Air entering  $\rightarrow$  Rt heart  $\rightarrow$  Pulmonary Circulation

•  $\uparrow$  PVR  $\downarrow$  left atrial filling  
• LV filling  $\downarrow \rightarrow \downarrow$  CO

•  $\downarrow$  In EtCO<sub>2</sub> /  $\uparrow$  PaCO<sub>2</sub>  
•  $\uparrow$  CVP

16. Postoperative cerebral vasospasm in a patient with a subarachnoid haemorrhage

- A. does not occur provided that the aneurysm has been clipped successfully F
- B. may be treated with calcium antagonists T
- C. usually occurs two weeks after operation F
- D. is prevented by postoperative ventilation f
- E. may produce a hemiplegia T

4th day  $\rightarrow$  10th day

17. In the diagnosis of brain-stem death

- A. clinical criteria are invalid in a hypothermic patient T
- B. caloric testing is used to test the integrity of the Vth cranial nerve f
- C. an isoelectric EEG is pathognomonic f
- D. absence of neuromuscular blockade should be confirmed with a peripheral nerve stimulator T
- E. reflex movements of the legs may still occur T

Vestibulo-ocular reflex  
III  
oculomotor  
abducent VI

18. Methods of reducing intracranial pressure include

- A. mannitol T
- B. sodium nitroprusside F
- C. ventricular drainage T
- D. isoflurane f
- E. nimodipine f

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- C. cardiac arrhythmias T
- D. a decrease in pulmonary vascular resistance f
- E. a decrease in intracranial pressure F

$\downarrow \text{PECO}_2 \rightarrow \text{VD} \rightarrow \uparrow \text{ET}$

• Air enter vein  $\rightarrow$  Rt heart  $\rightarrow$  pulmonary circulation

•  $\uparrow$  PVR,  $\downarrow$  left atrial filling  
• LV filling  $\downarrow \rightarrow$   $\downarrow$  CO

•  $\downarrow$   $\text{In Et CO}_2$  /  $\uparrow$   $\text{Pa CO}_2$   
•  $\uparrow$  CVP

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Subdural → From veins  
 Extradural → From arteries

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For 1<sup>st</sup> bridging veins - which cross subdura

19. **Acute subdural haematoma**

- A. results from haemorrhage from the middle meningeal artery **F**
- B. is frequently bilateral **F**
- C. is often associated with secondary bleeding following decompression **T**
- D. is a complication of chronic alcoholism **T**
- E. carries a good prognosis when associated with a basal skull fracture **F**

20. **The following are associated with increased intracranial pressure following head trauma:**

- A. papilloedema **T**
- B. pulmonary oedema **T**
- C. hypertension **T**
- D. a Glasgow coma score greater than 12 **F**
- E. bradycardia **T**

21. **A left sided double lumen endobronchial tube**

- A. can be used for left lower lobectomy **T**
- B. is suitable for a right sided broncho-pleural fistula **T**
- C. has a dedicated orifice for the left upper lobe bronchus **F**
- D. is used in preference to a right sided tube wherever possible **T**
- E. is contraindicated in a patient with a right pneumothorax **F**

22. **Recognised advantages of controlled ventilation in the treatment of flail chest include**

- A. reduction of paradoxical ventilation **T**
- B. the ability to use positive end-expiratory pressure (PEEP) **T**
- C. decreased pain **T**
- D. prevention of pneumothorax **F**
- E. accelerated healing of rib fractures **F**

23. **Appropriate treatment of moderate postoperative hypoxaemia following coronary artery bypass grafting in a ventilated patient with normal cardiovascular parameters includes**

- A. digitalisation **F**
- B. addition of positive end-expiratory pressure (PEEP) **T**
- C. dopamine infusion **F**
- D. sodium nitroprusside infusion **F**
- E. increasing the  $FiO_2$  **T**

10. Impairment of left ventricular function resulting from ischaemia during general anaesthesia

- A. occurs prior to ST segment depression *F*
- B. fully recovers when ST segment depression returns to normal *F*
- C. is best recognised by monitoring the pulmonary capillary wedge pressure *F*
- D. involves a decrease in left ventricular compliance *F*
- E. can occur in a normal heart *T*

11. True statements about endotracheal intubation include

- A. severe laryngeal lesions can be caused by endotracheal tubes *T*
- B. pneumomediastinum can occur *T*
- C. diffusion of nitrous oxide into air-inflated cuffs can double intracuff pressure *T*
- D. after 48 hours of intubation, endotracheal tubes should be replaced by tracheostomy tubes *F*
- E. most major cuff-related injuries result from use of inappropriately high cuff-to-tracheal-wall pressures *T*

12. Compared with the adequately spontaneously breathing patient, neuromuscular paralysis and controlled ventilation in the supine, anaesthetised patient are associated with

- A. improved overall matching of ventilation to perfusion *F* → basal atelectasis
- B. increased  $VD/VT$  *T*
- C. decreased anterior diaphragmatic motion *T*
- D. increased posterior diaphragmatic motion *F*
- E. improved venous return to the right heart *F*

13. Possible mechanisms for the bronchodilation, which occurs during halothane anaesthesia, include

- A. inhibition of release of bronchoactive substances *F*
- B. stimulation of beta-adrenergic receptors *F*
- C. inhibition of acetylcholine release within the lung parenchyma *T*
- D. inhibition of alpha-adrenergic receptors *F*
- E. stimulation of carotid body chemoreceptors *F*

direct action on airway smooth m.  
• Systemic distributed via CRAB  
• Central neurogenic reflex.



24. Atropine administration during anaesthesia to a patient with severe mitral stenosis can cause increased

A. myocardial oxygen consumption T  
B. left atrial pressure T  
C. left ventricular filling pressure F  
D. pulmonary capillary wedge pressure T  
E. cardiac output F

25. Recognised anaesthetic techniques for septoplasty include the use of

A. a throat pack T  
B. sodium nitroprusside induced hypotension F  
C. nasal preparation with topical cocaine T  
D. a nasogastric tube F  
E. anticholinergic premedication T

26. Traction on the medial rectus muscle of the eye produces

A. hypertension F  
B. bradycardia T  
C. mydriasis T  
D. Homer's syndrome F  
E. cardiac dysrhythmias T

oculocardiac Reflex

Afferent → Trigeminal n.

Efferent → Vagus n.

stimulus → Traction on EOM (Medial Rectus) Globe pressure ocular manipulation, ocular pain after enucleation.

Sinus brady  
- Inc. rhythm.  
- ectopics.  
- A-V Block  
- V. lach.  
- asystole

27. Recognised methods of providing pain relief in the early stages of labour include enucleation.

? A. thoracic epidural FF  
B. intrathecal analgesia FF  
C. intramuscular pethidine T  
D. hypnosis T  
E. nitrous oxide in oxygen T

28. During the third trimester of pregnancy there is

A. an increase in alveolar ventilation T  
B. a decrease in haematocrit T  
C. decreased basal metabolic rate F  
D. an increased blood volume T  
E. an increase in functional residual capacity F

Deoxygenated blood

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2 arteries  
umbilical artery  
pulmonary artery

29. Drugs which should be avoided in the first trimester of pregnancy include

- A. ondansetron T
- B. penicillin f
- C. metoclopramide F
- D. tetracycline T
- E. metronidazole T

30. The umbilical arteries

- A. originate from the fetal internal iliac arteries T
- B. convey venous blood from the fetus T
- C. contain blood at a  $PO_2$  of 5.3 KPa (40mmHg), f
- D. insert into the fetal inferior vena cava F
- E. are unaffected by autoregulation F

Supply deoxygenated blood from fetus to Placenta.  
2 umbilical a. & one umbilical vein.  
from internal iliac arteries.

Pressure inside C 50 mmHg

31. Post-laparotomy pain contributes to

- A. polyuria F
- B. nausea T
- C. hypoxaemia T
- D. decreased functional residual capacity (FRC) T
- E. tachycardia T

32. Section of the trigeminal ganglion results in

- A. facial paralysis f
- B. loss of salivary secretion f
- C. ptosis of the eyelid f
- D. vasodilatation of the facial skin f
- E. corneal anaesthesia T

33. Meralgia paraesthetica is relieved by nerve block of the

- A. lingual nerve F
- B. trigeminal nerve F
- C. lateral femoral cutaneous nerve T
- D. lumbar sympathetic nerve F
- E. femoral nerve F

numbness, tingling in outer thigh

from injury to lateral cutaneous nerve femoral



34. Side effects of opioid epidural analgesia include

- A. itching T
- B. hypotension F
- C. hypoventilation T
- D. sedation T
- E. urinary retention T

35. Factors influencing the level of a spinal block include the

- A. specific gravity of the anaesthetic solution T
- B. volume of the anaesthetic solution T
- C. dose of local anaesthetic T
- D. age of the patient T
- E. position of the patient T

36. Likely causes of coagulopathy in a patient who becomes septic following colonic resection include:

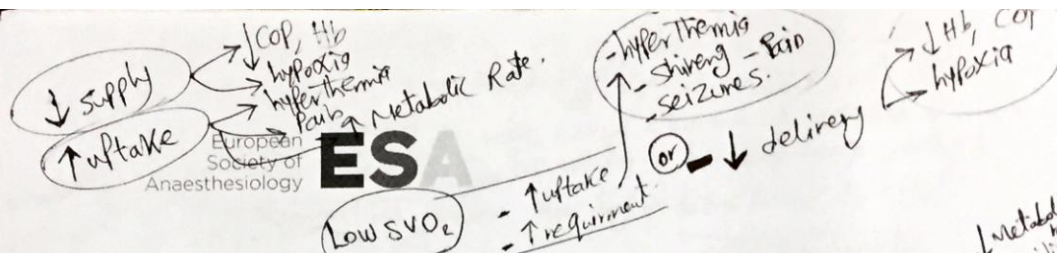
- A. deficiency of vitamin K F
- B. liver damage due to halothane F
- C. disseminated intravascular coagulation T
- D. unsuspected von Willebrand's disease F
- E. administration of low-dose subcutaneous heparin F

37. Reduction in cardiac output associated with high positive end expiratory pressure therapy (PEEP) is secondary to

- A. diminished venous return to the right heart T
- B. diminished left ventricular performance due to shift of the intraventricular septum T
- C. increased right ventricular afterload T
- D. decreased heart rate F
- E. carbon dioxide retention F

38. Positive end expiratory pressure (PEEP) decreases

- A. intrathoracic blood volume T
- B.  $\text{PaCO}_2$  F
- C. functional residual capacity F
- D. intracranial pressure F
- E. pulmonary capillary wedge pressure F



39. A decrease in mixed venous oxygen saturation is commonly due to

- A. decreased cardiac output **T**
- B. decreased metabolic rate **F**
- C. increased pulmonary artery pressure **F**
- D. a left to right shunt **F**
- E. decreased arterial oxygen content **T**

40. Possible causes of sudden onset of systolic and diastolic murmurs in a patient with infective endocarditis include

- A. pulmonary embolism **F**
- B. inferior myocardial infarction **F**
- C. prolapsed mitral valve cusp **T**
- D. aortic valve rupture **T**
- E. dissecting aortic aneurysm **F**

41. A high urinary osmolality is associated with

- A. diabetes insipidus **F**
- B. impaired renal function **F**
- C. mannitol administration **T**
- D. diabetic ketoacidosis **T**
- E. dehydration **T**

42. Suitable sedative agents for use in intensive care include infusion of

- A. propofol **T**
- B. midazolam **T**
- C. droperidol **F**
- D. etomidate **F**
- E. clonidine **T**

43. A low arterial PO<sub>2</sub> with a high PCO<sub>2</sub> is associated with

- A. pulmonary oedema **F**
- B. upper airway obstruction **F**
- C. lobar pneumonia **T**
- D. acute salicylate poisoning **F**
- E. exercise at high altitude **F**



\* Live site of Synthesis of All coagulation's Anti coagulation f.  
except → tissue thromboplastin, calcium IV, vnf VIII

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**ES**

\* also, site of Clearance of activated f.  
for warfarin dose, Liver damage, clotting f.

measure  
extrinsic  
path

44. In acute hepatic failure  
Prothrombin time 12-13 sec

measure how long it takes blood to clot

partial thromboplastin

used to see effect of Heparin.

- A. the prothrombin time is normal F
- B. serum alkaline phosphatase may be normal T
- C. serum albumin is often below 10gm/L F
- D. pulse oximetry is inaccurate in the presence of jaundice F
- E. serum LDH is a sensitive index of hepatocellular damage F

measure  
Intrinsic path.

30-50 sec

if ↓ may risk of thrombo embolism

if ↑ → heparin  
→ Antiphospholipid Ab  
→ hemophilia  
→ sepsis.  
→ Antibodies against factors

45. The urinary output of creatinine depends upon

- A. protein intake F
- B. urinary volume F
- C. glomerular filtration rate T
- D. catabolism F
- E. the muscle mass of the individual T

46. Probable causes of profound hypotension on commencement of artificial ventilation in a patient suffering multiple trauma include

- A. tension pneumothorax T
- B. hypovolaemia T
- C. cardiac tamponade T
- D. fat embolism F
- E. flail chest F

47. Physical signs characteristic of acute pulmonary embolism include

- A. dyspnoea T
- B. large 'a' wave on the central venous pressure (CVP) curve T
- C. systolic arterial hypertension F
- D. cyanosis T
- E. tachycardia T

48. Decompression sickness

- A. is associated with avascular necrosis of bone T
- B. is due to an alveolar oxygen deficit F
- C. is cured by breathing a mixture of oxygen and helium at atmospheric pressure F
- D. symptoms can occur four hours after the initial drop in pressure T
- E. is avoided if nitrogen is included in the inspired gas mixture F

49. Acute pancreatitis is associated with

- A. retroperitoneal haemorrhage T
- B. tetany T
- C. pleural effusions T
- D. gastric distension T
- E. hyperglycaemia T

50. Appropriate agents for reversal of acute bronchoconstriction include

- A. salbutamol T
- B. ketamine T
- C. adrenaline T
- D. sodium chromoglycate F
- E. atropine F

51. Factors correlated with increasing P(A-a)O<sub>2</sub> after surgery in the morbidly obese include

- A. location of incision T
- B. type of incision T
- C. weight/height ratio T
- D. location of excess body fat T
- E. intraoperative paralysis and artificial ventilation T

52. Findings associated with near drowning in fresh water include

- A. atelectasis T
- B. increased lung compliance F
- C. loss of pulmonary surfactant T
- D. increase in pulmonary venous admixture T
- E. haemolysis T

53. The "blood-brain barrier" *Brain endothelial cells*

- A. is formed by the arachnoid villi F
- B. is less permeable in the newborn F
- C. is freely permeable to bicarbonate ions F
- D. does not permit free passage of organic anions T
- E. has similar functional characteristics to a cell membrane T

(BBB)

- highly selective semi-permeable membrane  
- Separate circulating blood from brain & extra cellular fluid in CNS  
→ allow passively → water  
→ some gases  
→ lipid soluble molecules  
\* occur along all capillaries



54. Neonates with respiratory distress syndrome have

- A. decreased alveolar perfusion T
- B. left-to-right cardiac shunts F
- C. increased work of breathing T
- D. normal alveolar surfactant activity F
- E. a metabolic alkalosis F

55. Concerning the neonatal respiratory system:

- A. the narrowest part of the airway is below the glottis T
- \* B. thoraco-pulmonary compliance is higher than in the adult T
- C. the mainstem bronchi leave the trachea at roughly equal angles T
- D. the glottis lies higher in the neck than in the adult T
- E. inspiration is predominantly diaphragmatic T

56. Immediate treatment of an asthmatic child, unsuccessfully treated with epinephrine (adrenaline), who has become hypoxic, drowsy, hypercarbic and acidotic includes

- A. administration of sodium bicarbonate F
- B. intravenous diazepam F
- C. aminophylline infusion F
- D. intubation and ventilation T
- E. nebulised salbutamol F

57. Concerning low platelet counts:

- A. before major surgery they should be increased to at least 50,000/ml T
- B. in the non-surgical patient, counts of 40,000/ml are associated with increased haemorrhage F
- C. platelet concentrate administration is the preferred method of treatment T
- D. fresh frozen plasma should be administered to thrombocytopaenic patients prior to surgery F
- E. they are invariably associated with altered platelet function F

58. Thyroid stimulating hormone (TSH)

- A. increases blood flow to the thyroid gland T
- B. is released from the hypothalamus F
- C. is available as a synthetic product T
- D. is elevated in iodine deficiency T
- E. concentration is used to monitor thyroid hormone replacement therapy T

2 >

59. In pre-renal oliguria

- A. urinary sodium concentration is greater than 75mmol/l
- B. urinary specific gravity is greater than 1015
- C. urine/plasma osmolality ratio is greater than 1.8
- D. urine/plasma urea ratio is greater than 10
- E. urine/plasma creatinine ratio is greater than 30

Actively reabsorbed  
in pre-renal state

Sub  
urinaemia

$< 20 \text{ mEq/l}$

60. Differential diagnoses of an enlarged heart shadow observed on a chest X-ray include

- A. congestive cardiac failure T
- B. pericardial effusion T
- C. mitral valve disease T
- D. hypertrophic subaortic stenosis T
- E. hiatus hernia T



# Alveolar Partial Pressure of Oxygen equation

$$PAO_2 = f_{iO_2} \left( \underset{760}{P_{ATM}} - \underset{47}{P_{H_2O}} \right) - \frac{P_a CO_2 \underset{40}{}}{\underset{0.8}{R}}$$

TFTTF

~~respirator equation~~

Partial pressure of water  
47 mm Hg

$$PAO_2 = 0.21 (760 - 47) - \frac{40}{0.8} = 99.7$$

at sea level